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From origins to implications: key aspects in the debate over the digital divide

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Abstract
Defined as the differential extent to which rich countries and poor countries benefit from various forms of information technology (IT), the global digital divide has been extensively measured and described in national as well as international debates. The problem, however, is that the topic is highly fragmented in the literature, with few attempts to put the parts into a coherent analytical framework. More precisely, there has been no specific attempt to pinpoint the main issues that influence one's view of the importance of the digital divide and the policies demanded by the different points of view. The goal of this paper, accordingly, is to fill this important gap in the literature in an analytical schema that recognizes the ways in which the impact of innovations depends heavily on how they are generated and diffused. At each stage of this sequential process are key issues that influence one's view of the digital divide. It matters a great deal for instance on whether the divide is in some sense unique, or just another manifestation of the general technological relationship between rich and poor countries. It is also the case that the size of the divide depends heavily on how it is measured. Yet another example is that the extent of the potential impact of IT will influence our view of the foregone opportunities associated with limited uptake of this technology in developing countries.
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Introduction

Simply put, the global digital divide concerns the starkly differential extent to which various forms of information technology (IT) (such as the Internet, computers and mobile phones) benefit rich countries rather than poor countries in terms of production as well as use (a distinction that is described below). By now, the topic has engendered intense interest among a very wide range of institutions at the global, international and country levels. Yet, in spite of the huge amount of literature, there has been no specific attempt to pinpoint the main issues that influence one's view of the importance of the digital divide and the policies demanded by different points of view. The goal of this paper is to fill this important gap in the literature by means of an analytical schema that recognizes the sequential aspect of the process in which the impact of innovations depends on how they are generated and then diffused across countries.

As shown in Figure 1, there are key issues that influence one's view of the importance of the digital divide at each stage of the sequential framework. It matters a great deal, for instance, whether one takes the view that this divide is in some sense unique or that it is just another of the many technical differences generated by the interaction between rich and poor countries (as discussed in the first phase of the diagram). At the next stage of diffusion of ITs, the size of the digital divide may depend heavily on how it is measured. As the last example, it is the extent of the potential impact on growth and poverty that will surely influence our view of the foregone opportunities associated with limited uptake and diffusion of IT in developing countries. Moreover, the sequential nature of the process depicted in Figure 1 suggests that issues arising at one stage may influence those occurring at subsequent stages. The impact of IT may depend, for instance, on the degree to which it is adopted in a particular country because of the need for the critical mass to realize the potential benefits.

Following the logic of the schema, I begin with a discussion of the generation of IT and conclude with my

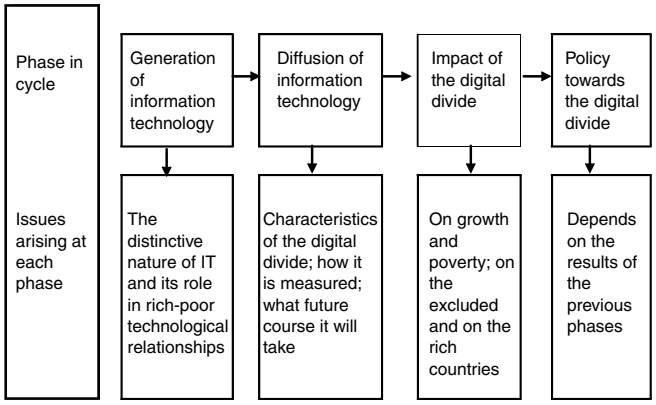

Figure 1 The analytical schema.

own perspective on the policies that are needed to close the digital divide. More generally, this paper should be considered in part as a critical evaluation of the available literature and partly as a reflection of my own opinion where the literature is inconclusive.

The source of the digital divide

It is well to emphasize at the very outset that IT belongs to a special category of innovations whose emergence in society occurs only very infrequently. In particular,

> The term 'general-purpose technology', or GPT, has seen extensive use in recent treatments of the role of technology in economic growth, and is usually reserved for changes that transform both household life and the ways in which firms conduct business. Steam, electricity, internal combustion, and information technology (IT) are often classified as GPTs for this reason. They affected the whole economy (Jovanovic and Rousseau, 2005: 1).

Some forms of IT (such as the Internet and mobile phones) operate in firms as well as households. Other forms, however, function in only one of the two institutions. Computer-aided design (CAD) and computer numerically controlled machine tools, for example, are found only in firms, while certain types of software applications (such as computer games) are used only by households.

In terms of the key issues thought to be at stake in the digital divide debate, the enormous breadth of scope of IT, in terms of the numbers of economic agents involved and the variety of different (information) technologies that serve them, has a number of implications. One of them, for example, is that there are effectively two possible divides, one associated with production (or, more generally, ways in which firms conduct business) and the other concerned with use in households.[1] And for certain poor countries, it may make sense to focus initially on closing the one divide rather than the other (if, for instance, the capabilities required for use are less stringent than those demanded by actual production).[2] Probably the most telling implication of viewing information as a general purpose technology (GPT), however, is the vastness of the scope that it potentially affords a country for improving productivity and efficiency and more generally for raising the overall well-being of its members. From this point of view, as I shall argue below, it becomes difficult, if not impossible, to view the digital divide as a 'non-issue'.

If, as a GPT, IT does indeed differ from more routine types of innovation, it does not automatically follow, therefore, that the digital divide should be viewed as an entirely new and unique aspect of the technological relationship between rich and poor countries. My own view is that the digital divide should be viewed instead as part of the same general mechanism that gives rise to other technology gaps between these two groups of countries (or, to be more precise, between all countries ranked in terms of per capita income). The mechanism in question was described many years ago by Singer (1970), who referred to it as 'international technological dualism'. This arose, in his view, from the acute concentration of global R&D in the rich countries (amounting even now to more than 90%), which would lead, as he saw it, to a situation where global innovative activity was such as to exclude not only developing countries but also many transitional economies, with this large excluded group representing one reflection of the technological dualism between countries. Singer also recognized, however, that this globally concentrated form of innovative activity would not *necessarily* constitute a bias against developing countries as it was possible, in principle, that

> the direction of advance, the scientific and technological priorities and the methods of solving scientific and technological problems, were independent of where the work is carried on. This, however, is patently not the case, the (then) 98 per cent of research and development expenditures in the richer countries are spent on solving the *problems which concern the richer countries,* according to their own priorities, and on solving these problems by the methods and approaches appropriate to the factor endowment of the richer countries. In both respects … the interest of the poorer countries would be *bound to point in completely new directions* (Singer, 1970: 62, emphasis added).

They would point, for example, towards innovations that are not heavily dependent on the weak infrastructure (including telecommunications) that is found in most developing countries; towards innovations that are not heavily reliant on highly skilled labour and managerial inputs; towards new technologies that are suited to local rather than developed country institutions and income levels. No less than with other technological divides, however, the global divide in IT reflects the general absence of innovations with these and other characteristics that a specific focus on poor countries would dictate (certain exceptions can easily be cited).[3] As such, the global digital divide seems in essence to reflect yet another technological gap, derived from the same source, rather than an entirely new aspect of the relationship between rich and poor countries (though, of course, there are certain distinctive aspects of the global digital divide, such as the fact that some developing countries benefit from the enhanced

ability of multinational corporations to globalize their research operations).[4]

And again, in common with other innovations emanating from the rich countries, the advances in IT can be expected to exhibit systematic patterns of adoption and diffusion within and between different countries. In the first place, one might expect IT (and new technology in general) to be most extensively adopted in countries that most closely resemble the socio-economic features of developed countries, or, more simply, countries with per capita income levels closest to those in the industrialized parts of the world. Relatedly, one should expect to find that, *within* countries, IT takes hold predominantly in those sectors that most closely approximate the conditions prevailing in the innovating country. In general, this means urban sectors with relatively high incomes and education levels. Note in this regard that, even in the most prolific innovator of IT, the United States of America, a fierce debate has raged over the digital divide between different segments of the population, a debate that has many parallels with the issues raised in connection with the global divide. For example, a 2002 report by the US Department of Commerce purported to show that poorer families in that country were adopting the Internet more rapidly than richer families, leading some observers (such as Compaine, 2001) to suggest that the digital divide was closing quickly.[5] Others, however, refuted this conclusion based, for example, on the recognition that 'the annual growth rate is biased toward groups with low initial percentages' (Martin, 2003: 4), or on the view that there are unique aspects of the Internet, such as the required cumulative set of sophisticated skills, which make it different from other forms of communication media (Mason and Hacker, 2003).

Let us now examine how these implications of international technological dualism are reflected in actual patterns of adoption and diffusion with respect to those forms of IT that are especially prominent in the digital divide debate, namely the Internet and mobile telephones. These technologies have the advantage of capturing both firm and household adoption, and they are, furthermore, the only forms of IT for which reliable cross-country data are available.

Adoption and diffusion of ITs in rich and poor countries

As a summary first view of the current state of the digital divide, Table 1 contains data on the diffusion of the Internet and mobile phones for the four country income categories used by the World Bank, namely, the high-income, upper-middle-income, low-middle-income and low-income countries. For both technologies, the divide is reflected, as expected, in a clear tendency for the entries in the table to vary positively with the income level of the country grouping. More precise estimates of the role played by income and other factors in explaining the digital divide have been undertaken by a number of authors (Dewan *et al*., 2004; Chinn and Fairlie, 2004). These cross-country studies are useful, among other reasons, because they are able to separate the influence of income from numerous other closely related variables such as education. Indeed, a review of most of this literature finds 'a few results that are fairly consistent: national income and infrastructure are important factors in IT penetration levels, and depending on the countries examined, education and policies are also important' (Dewan *et al*., 2004). Not only therefore, do these findings rigorously confirm the summary pattern shown in Table 1 (confirming the existence of digital divides among each pair of country groupings shown there), but they also draw attention to the other major variables along which countries vary in terms of their digital penetration. In the language of the previous section, these other variables represent the most important respects (other than income) in which socio-economic differences between rich and poor countries contribute to international technological dualism. (Evidence can also be adduced in support of the predicted pattern of internal technological dualism, but it is thus far based on evidence drawn from relatively few developing countries.)

What has attracted most attention in the most recent debates about the diffusion of IT in rich *vs* poor countries, is not so much the evidence presented so far in this section. Today, the principal concern relates to the *change* in the extent of the digital divide over the last decade or so. Consider, for example, what occurred over the period from 1994 to 2004, as shown in Table 2, where the division into developed and developing countries conforms approximately to the division between high-income countries and other countries in Table 1.

For 1994, the table indicates the number of Internet users and mobile phone subscribers per 100 inhabitants in developed and developing countries (with the numbers of mobile phone subscribers shown in Table 2b). In particular, there were at that time, 2.18 Internet users per 100 inhabitants, in the developed countries in contrast to the figure of 0.03 for the developing world. For mobile phones the corresponding figures were 5.2 and 0.19, respectively. Measured in *relative* terms, the size of the digital divide shown in the last row of Table 2 reflects the fact that there

Table 1 Diffusion of IT by country groupings, 2004

Country grouping according to the World Bank	*Internet users (per 1000 people)*	*Mobile subscribers (per 1000 people)*
High-income countries (e.g. UK, USA, Japan)	480	767
Upper-middle-income countries (e.g. Seychelles, Mexico, Malaysia)	133	490
Low-middle-income countries (e.g. Thailand, Honduras, Namibia)	70	255
Low-income countries (e.g. Nicaragua, Ethiopia, Pakistan)	20	48

Notes: Figures are averages of the four country groupings.
Source: World Bank (2006).

Table 2 The digital divide 1994–2004

	1994 [a]	*2004* [a]
(a) The Internet		
Developed countries	2.18	53.8
Developing countries	0.03	6.7
Size of the digital divide (relative terms)	73 times more	8 times more
(b) Mobile phones		
Developed countries	5.2	76.8
Developing countries	0.19	18.8
Size of the digital divide (relative terms)	27 times more	4 times more

Notes: [a]Numbers for Internet users and mobile subscribers are per 100 inhabitants.
Source: ITU (2006a).

were, respectively, 73 and 27 times more Internet users and mobile phones in rich countries than in poor countries. (Note that the divide can also be measured in *absolute* terms, as the subtraction of the two amounts, rather than a division of the one by the other.)

By 2004, however, marked reductions had occurred in the size of (the relative) digital divide for Internet users as well as mobile phone subscribers. In the former case, the divide shrank from as much as 73 to 8 and in the latter from 27 to 4 (though, in both cases, the size of the absolute gap *increased* by very large amounts).[6] Underlying these changes are, of course, higher average annual rates of Internet use and mobile subscriptions in the developing countries. One's view of how important the digital divide actually is will thus tend to be heavily influenced by whether this concept is measured in absolute or relative terms. In the former case, the growing division between the stock of IT in rich and poor countries, would be viewed with considerable concern. In the latter case, by contrast, the more rapid growth of this technology in developing countries presents a more optimistic picture. It turns out, however, that one cannot simply focus on one rather than the other measure as they are related to one another. In particular, the size of the absolute divide determines how long it will take a given relative advantage in favour of developing countries to catch up with the developed countries. Conversely, for any given absolute divide, it is the rate at which higher growth occurs in the poor countries that is important, for the duration of the catching-up process. Either way, though, the relative concept is important and a key issue is what the higher recent growth rates achieved in those countries imply for the future course of the digital divide.[7]

For some authors such as Fink and Kenny (2002), the rapidity with which the relative digital divide has already begun to close signals that the issue is much less formidable than was originally thought and, indeed, is no more problematic than earlier divides in technologies such as television, radios or even air conditioners. To quote from those authors, 'The most stunning feature of the digital divide is not how large it is, but how rapidly it is closing' (Fink and Kenny, 2002). Nor, in their view, is there any reason to suppose that the rate of diffusion of IT will fall behind that of developed countries in the future. On the contrary, 'if history is any guide, growth rates are likely to remain higher in the developing world'. For other writers, by contrast, much more caution needs to be exercised in extrapolating the recent trends shown in Table 2 into the future, or, interestingly, in a very similar debate, extrapolating recent data from the United States, which shows that computer and Internet use are 'increasing most rapidly among the poor and other disadvantaged groups' (Martin, 2003: 2). Perhaps the most fundamental problem these authors have with simple extrapolations of recent trends is that the growth rates of IT in developing countries have a base level of almost zero (see Table 2). From that negligible level, simple arithmetic shows that even only minor absolute increases will register as phenomenally high growth rates with a correspondingly impressive shrinkage of the digital divide (James, 2006a).

Another reason for doubting that recent trends in the diffusion of IT can be easily extrapolated into the future has to do with the distinctive nature of the technology itself. Mason and Hacker (2003: 45), for example, argue that 'The Internet and IT in general are not the same as previous communication media'. Because whereas advances in say radio and television 'fall along the lines of improved quality, advances in IT allow for increasingly complex tasks, requiring a cumulative set of sophisticated digital skills'. Such skills, they rightly suggest, are 'hardly comparable to owning a radio or TV set'. The demanding user capabilities associated with the Internet assume particular significance in the context of future developments in the global digital divide. In contrast to developed countries, only a minority of the population in the Third World (typically those with relatively high incomes, advanced levels of education and skills and resident in urban rather than rural areas) is likely to possess these capabilities. Insofar so far as it is this minority that first adopts the Internet, as available evidence suggests, adoption is likely to become significantly more difficult from a capabilities point of view as shown schematically in Figure 2.

Mobile telephony, one should note, suffers much less from the constraints of user capabilities and to this extent (in combination with a relatively low entry price) may witness a more rapid closure of the digital divide, especially in the poorest regions where the lack of user capabilities is

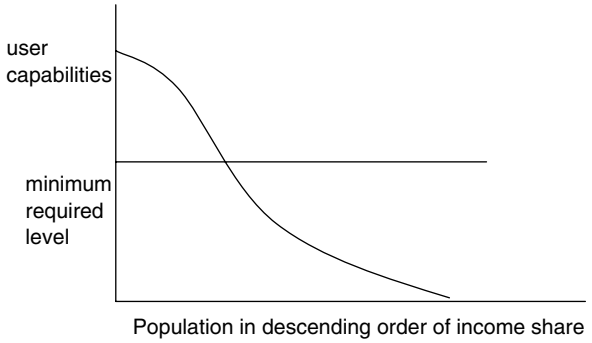

Figure 2 Stylized distribution of Internet user capabilities by income share of the population in a developing country. Population in descending order of income share. Note: The point at which the curve crosses the line is chosen arbitrarily. *Source*: James (2006a).

most pronounced (though, as noted below, it does suffer from an affordability constraint).[8]

It is Africa, the world's poorest region, that has seen by far the most rapid rate of mobile phone subscriptions in recent years. In particular, between 1998 and 2003 a growth rate of 1000% was recorded, leading in the last year to an absolute number of over 50 million. One year later, in 2004, there were no fewer than 76 million subscribers (Gray, 2006). Tellingly, the rate of growth of Internet users between 1999 and 2004, from 0.37 to 2.12 per 100 inhabitants was much less. This difference, however, is not solely due to the variation in the required degree of user capabilities noted above but also to the fact that infrastructural problems are generally far less pronounced in the case of mobile telephony. Whereas, for example, connectivity is still a major problem of Internet access in rural areas of poor developing countries in general and Africa in particular, with mobile coverage 'its cheapness and ease of installation mean that [it is] growing rapidly in many countries, as illustrated by Bangladesh, where .... Coverage has grown from 36% in 2003 to a planned 85% coverage by the end of 2005' (ITU, 2006b: 12).

It bears emphasizing, however, that what is being argued here is *not* that rapid future growth of mobile phones can somehow be taken for granted. One still needs to recognize that in the poorest countries 'mobile ownership is still mainly for the privileged middle class and elites in urban areas. For many others, the costs of mobile ownership and use remain prohibitively high' (Donner, 2005: 2). It is true that the number of users will always be higher than the number of owners because of various types of sharing mechanisms (within the household or through the rental of telephone time), but as yet there are no data that can tell us the exact extent of the difference between owners and users of mobile telephony in a particular country.[9]

Regardless of one's predictions about the future rates of growth in IT, however, the digital divide described above can only be grounds for concern (leading to policy intervention) if there were significant benefits to IT usage or negative consequences from non-usage. Even if both conditions are satisfied, the question remains as to whether and why *developed* countries should regard the digital divide as an issue of concern to them. Accordingly, I now turn to these important questions.

The impact of the digital divide

As noted in the previous section, there remain vast numbers of those living in poor countries who have no access whatever to the major forms of IT. But whether and to what extent this fact will be of concern to policy-makers in those countries depends rather heavily on the potential gains (and losses) that access could provide.[10] From an economics point of view, the most important potential gain is an increased rate of growth in a particular developing country. From a social perspective, by contrast it is arguably the impact on poverty that matters most (though, of course, an increase in economic growth can also be expected to have a favourable effect on those living in conditions of poverty).[11] I begin this section, therefore, by assessing the role that IT could potentially play from these perspectives. I deal next with the *absolute* losses that *non-adoption* of this technology might inflict on the developing world. Even if it turns out, however, that there are vital potential gains at stake and that sizeable losses are being inflicted on poor countries, it is far from obvious why this should in any way concern the rich countries. The final part of this section thus examines the digital divide from the perspective of the latter countries.

The potential impact on growth

Most investigations of the relationship between IT and economic growth have focused on developed countries and many of them find that this technology contributes a good deal to the growth of those economies albeit with a time lag (e.g. Jorgenson *et al.*, 2005). Indeed, 'there is a general consensus that ICTs have a clear impact on economic growth by increasing productivity' (ITU, 2006a). According to Varian (2006) for example, 'Most economists agree that IT is a significant explanation for the post-1995 productivity surge in the United States'. One cannot, however, simply assume that these estimates reflect the extent of the opportunities open to developing countries, where the impact of IT on growth has received much less attention. In fact, there appear to be differences in the productivity gains from the new technology even among the developed countries themselves. According to Varian (2006), for instance, the European economies have not enjoyed the same productivity growth over the past 10 years as the United States has. The difference, it seems, lies in the effectiveness with which IT is used in the two regions. Citing research conducted at the level of firms, Varian indicates that organizational differences may play an important role. 'Just dropping a bunch of new personal computers on workers' desks is unlikely to contribute to productivity. A company has to rethink how business practices are handled to get significant cost savings' (Varian, 2006).

In developing countries, the potential gains from computers and other forms of IT are likely to depend on more fundamental issues than just business practices. Here, I have in mind the whole range of factors – such as infrastructural weaknesses, limitations in user capabilities, reliable maintenance suppliers and effective repair facilities – that limit the ability of developing countries to use technologies such as the Internet in an effective manner (mobile phones present a different story as shown below).

The same problems, interestingly, have already emerged from research into the effectiveness of infrastructural use in developing countries rather than developed and certain East Asian countries. In particular, Hulten (1994) has shown how different the growth rate in Africa might have been had they operated their infrastructural stocks with the same effectiveness as the four Asian NICs (newly industrializing countries) had. Using measures such as mainline faults per 100 telephone calls and the percentage of paved roads in good condition, he finds that if the former countries had operated their infrastructure as effectively as the latter, 'their average growth rate would have been 0.75 per year rather than –0.20' (Hulten, 1994: 23). To what extent similar limitations reduce the full potential that IT offers is hard to say, not least because of the present state of research, which is focused almost entirely on developed countries. Fortunately, however, there is at least one serious study of IT and growth in developing countries that provides us with more solid evidence of the potential *now* being foregone by countries at the wrong end of the digital divide.

The study in question was conducted by Waverman *et al.* (2005) and follows on from his earlier research into the impact of 'modern fixed-line telecoms networks' in the OECD countries, which was 'responsible for one third of output growth *between* 1970 and 1990' (Waverman *et al.*, 2005: 10). Waverman *et al.* (2005) 'find that mobile telephony has a positive and significant impact on growth *and this impact may be twice as large in developing countries compared to developed countries*. The result concurs with intuition. Developed economies by and large had fully articulated fixed-line networks in 1996 … In developing countries, we find that the growth dividend is far larger because here mobile phones provide, by and large, the main communications networks; hence they supplant the information-gathering role of fixed-line systems' (p. 11, emphasis in original). A few examples provided by the authors help to get a sense of the magnitudes involved. One of the most telling is that 'A developing country which had an average of 10 more mobile phones per 100 population between 1996 and 2003 would have enjoyed per capita GDP growth that was 0.59 percent higher than an otherwise identical country' (p. 11). One of the most important conclusions of this study has a direct bearing on the question of why the digital divide should be taken seriously by developing countries. In particular 'If gaps in mobile telecoms penetration between countries persist, then … this gap will feed into a significant difference in their growth rates in future' (Waverman *et al.*, 2005: 19). Indeed, for some developing countries, it is quite possible to imagine them being caught in a vicious circle, where poverty inhibits the adoption of mobile telephony, which in turn perpetuates the initial situation.

I know of no directly comparable study with respect to the impact of the Internet in developing countries. There is, however, some evidence regarding the potential of this technology to promote exports from these countries. In particular,

> The Internet can be especially valuable for firms in developing countries because it provides opportunities to connect to markets and participate in trade, domestic and foreign. A recent survey of 56 developed and developing countries found a significant link between Internet access and trade growth – with *the greatest benefits accruing to developing countries with the weakest trade links* (World Bank, 2006: 4, emphasis added).

I have emphasized the last sentence of this citation, because it is entirely analogous to the case of mobile phones, which were shown to have the most positive influence in countries with the weakest communications linkages (such as those without a pre-existing fixed line network). In both cases, it would seem that, the gains tend to be greatest among the poorest developing countries. From another point of view, however – of network externalities – these same countries might suffer from the problem of critical mass. In order to benefit substantially from the societal benefits that accrue from individual adoption of IT a certain minimum number of users may be needed.

The potential impact on poverty

As we have just seen, the spread of one form of IT, mobile phones, has a major positive influence on growth in developing countries. If this increased growth also translates into less poverty, one can say that this technology simultaneously promotes two of the most important goals pursued by developing countries with the added possibility of mutually beneficial interactions between them. What then does the available evidence have to say about the impact of growth on poverty in those countries? The *Human Development Report* for 2003 provides a brief but precise summary. In particular,

> Many studies have calculated an 'elasticity of poverty to average income' – the percentage decline in the head-count poverty ratio for each 1% increase in per capita income. A typical estimate in the vast econometric literature, holding constant the distribution of income, is that the poverty rate declines by 2% for each 1% increase in average per capita income, for an elasticity of 2 (UNDP, 2003: 67).

More recently, Kraay (2005) has shown that 'especially in the medium-to long run, cross-country differences in growth in average incomes are the dominant factor explaining changes in poverty' (p. 26).

In this indirect way, therefore, via the dual causality between poverty and growth, it appears that mobile phones do have a potentially crucial impact on the former in developing countries and especially in the rural areas of those countries that have no other means of communication. It is a potential that represents nothing less than the opportunity for developing countries to escape from a poverty trap, in which high poverty lowers the growth rate and hence the ability to escape from poverty.[12] Unfortunately, however, the evidence concerning the *direct* influence of this or any other form of IT on poverty is very scant. Indeed, as far as I am aware, only the case of Grameen Telecom has been at all seriously studied from this point of view (by, among others, Bayes *et al.*, 1999). As an extension of the original Grameen Bank endeavour

Table 3 The potential impact of IT on selected MDGs (at the national level)

	Inputs	*Outcomes*
Poverty reduction	Wider diffusion of ICT access among farmers	Increased annual income (e.g. from increased market income due to better price information)
Universal primary education	Increased number of teachers trained, using ICT-supported in-service training	More pupils taught where training supported by ICT
Gender equality	Number of ICT activities directed at women trained	Positive changes in women's status and employment based on ICT
Child mortality	More connected rural clinics	Lower mortality rates in ICT-supported clinics
Combat HIV/AIDS	New opportunities to access advice by phone or online	Fewer new cases of HIV/AIDS and improved treatment for those who are infected

Source: ITU (2006a, Table 5.1).

to make small group loans to its (female) members, the idea of the Telecom project is to lend money to a Bank member in each village in Bangladesh for the purpose of purchasing a mobile phone. The phone owner then sells call-time to the other villagers, who, it seems, are willing to pay a relatively high proportion of their incomes on this service (which, incidentally, includes notification of any incoming calls).[13] Unlike many attempts to use IT for the benefit of the rural poor, the impact of Grameen Telecom extends well beyond the level of a particular village or region. In fact, some estimates suggest that approximately 45 million villagers in Bangladesh now have access to a mobile phone, thanks to the Telecom endeavour. Furthermore, the same basic model has been introduced with some success in two poor African countries, namely, Uganda and Rwanda (Grameen Foundation, n.d.).

There are, of course, many other direct mechanisms through which IT can benefit the poor, involving not just mobile phones but also computers and the Internet. Table 3, for example, shows some of the ways in which being connected can and, to some extent, already does contribute to the well-known Millennium Development Goals (MDGs), one of which is explicitly about poverty reduction, while the others have to do with a broader range of poverty-related measures. The extent of that contribution in actual practice, however, remains to be established. The full list of goals and the way in which they are measured can be found on the site of the Millennium Project, which was commissioned by the UN Secretary General in 2002 to address basic problems related to extreme global poverty (United Nations, n.d.). (These include health, education, gender equality, infant mortality and maternal health.)

The impact of the digital divide on excluded countries

Thus far, I have been discussing only the potential benefits of IT for (developing) countries that have not as yet adopted it. Nothing has been said, however, about the *losses* that *non-adoption* might entail, a situation that is to say, where countries at one end of the digital divide inflict absolute losses on those at the other end. Yet, this latter possibility might potentially give the excluded countries as much cause for concern about the divide as the former. It is most likely to arise, as I see it, from the well-established connection between IT and comparative advantage in international trade[14] and in particular the connection that resides in the way this technology originates and spreads unevenly across countries. For, as described in earlier sections, the origin of most innovations imparts a systematic tendency for them to be adopted in rich rather than poor countries. Because of the competitive advantages thus bestowed on the former in the realm of international trade, one has to wonder whether this will undermine the manufactured exports from poor countries in a process referred to as 'comparative advantage reversal'.

The process is best illustrated in the textiles and garments industries, which traditionally have been dominated by labour-intensive products from developing countries (in most of which, moreover, these industries comprise a relatively high proportion of manufactured exports). The introduction of process innovations in IT has allowed manufacturers in developed countries to counter the advantages of cheap labour with speed and flexibility in segments of the garment industry that are especially prone to sudden changes in demand (which for the most part means the more fashion oriented and brand conscious segments of the industry). Indeed, 'best practice American producers can now deliver orders with just a few days' notice, something overseas suppliers have difficulty achieving. These US firms do so through electronic data interchange (EDI) automated distribution centers, and sophisticated inventory management' (Abernethy *et al.*, 1999: 8). In a manner that is similar to the role played by just-in-time techniques in the automobile industry, the so-called 'lean retailing' has shifted the comparative advantage of many types of garment back to the United States and other developed countries. A more recent model of lean production in the clothing market can be found in the operation of the Spanish retailing firm 'Zara', which routinely creates and rapidly replenishes small batches of new products. Zara is frequently able to compete with high-fashion houses on the basis of both speed to market and price, by supplying virtually identical products made with cheaper fabric. This 'fast fashion' concept relies on a continuous flow of information within every part of the firm's supply chain (Ferdows *et al.*, 2004).

Not all developing countries suffered from a corresponding reversal of their comparative advantage based on low labour costs. What seems to have occurred instead is that multinational firms have often sought a combination of quick turnaround and low production costs by locating in countries near the US and Europe.

> The United States imports so much from nearby countries primarily because their products arrive quickly. The Wal-Mart model that now dominates retailing requires apparel suppliers to replenish products on a weekly basis. As that model took over in the 1990s, so too did the advantage of sourcing certain apparel items closer to the US market so that products could be manufactured and delivered more rapidly. This also explains how some segments of the US apparel industry have survived even with cheaper labor elsewhere in the world. Costs remain a driving factor, but the proximity advantage will grow even greater in a post-quota world as retailers raise the bar even higher on the responsiveness and flexibility required of their suppliers. (Abernethy and Weil, 2004).

Countries far from major markets on the other hand suffered a decline in market share, as Abernethy *et al.* (1999) demonstrate for the period between 1991 and 1997 in the United States. The major losers were Hong Kong, Taiwan and Korea, whose collective share in US apparel imports declined from 38 to 16% over that period (although, of course, other factors may also have played a role). Much of that decline accrued to the United States and other developed countries. Assuming that the total size of the US market did not increase proportionately, those countries can be said to have experienced a comparative advantage reversal. Not all developing countries that are located far from a major developed country market, however, are at risk in this regard. Some of them, such as those in Sub-Saharan Africa, tend to produce relatively low-quality (non-fashion-prone) garments for regional markets. Others, even those producing for developed country markets, specialize in garments for the low-end, price-conscious market segments that are driven by costs rather than fashion and brands. The general point, however, is that the risk of comparative advantage reversal is not uniform across developing countries.

Looking at the future, on the other hand, what does seem inevitable (as noted in the previous citation) is growth in the high end of the market for goods such as clothing and footwear, which are characterized by rapid changes in demand, brand consciousness and fast turnaround times (sometimes referred to as the 'new competition' in world trade). The reason for this is that as incomes grow consumer demand shifts inexorably in favour of products that are intensive in 'fashion' relative to basic or functional characteristics. This shift can only become more pronounced in a globalized world where the availability and desirability of such fashion-intensive goods become ever more apparent, as a result of the spread of television and Western advertising media in even remote parts of the Third World.

Should developed countries be concerned about the digital divide?

In this section, the question that remains to be asked is why the digital divide need be of any concern to the *developed* countries. The answer is far from obvious as it is these very countries that benefit most from the adoption and diffusion of technologies such as mobile phones, the Internet and CAD/CAM (computer-aided design and manufacture). And indeed, there is one influential school of thought that views any form of global inequality as being 'irrelevant' (Milanovic, 2005). It is thought to be irrelevant partly because there is no global government and there is no global civil society. According to this view, national inequalities matter because 'they become a stuff of political discourse; they are used to form political parties, platforms, to organize interest groups. But at the global level none of that exists because there is no global polity' (Milanovic, 2005).

Another school by contrast, sees global inequality in general and the digital divide in particular in ethical terms, which imply among other things, that 'the rich world cannot disown all interest in global poverty and inequality; to some extent, the fate of every individual in the world affects us. Distributional justice within a nation, and in the world as a whole, is … from an ethical perspective … the same thing' (Milanovic, 2005). By the same ethical logic, the rich world cannot simply ignore the digital divide, since it is an important source of global inequality. The United Nations certainly sees the digital divide from this ethical perspective, because it impedes poor countries from entering the information age and perpetuates this condition (Spinello, 2005).

Ultimately, however, it is on the basis of economic self-interest that the rich countries may become concerned over the digital divide and more specifically in the form of multinational corporations with headquarters in those countries. According to one prominent theory, for example, it is the digitally excluded countries that are becoming especially attractive targets for foreign investments in IT. 'The real source of market promise' according to this view, 'is not the wealthy few in the developing world, or even the emerging middle-income consumers: It is the billions of *aspiring poor* who are joining the market economy for the first time' (Prahalad and Hart (2002: 3) emphasis in original). The basis for this view is essentially that certain products, including ITs, can profitably be designed for the poor on a large scale with low profit margins. Via its Indian subsidiary, for example, Unilever designed a low-cost ice-cream product that was based on 'an inexpensive and reusable heat shield that could keep the product cold for 24 h and replaced the need for refrigeration in vending machines' (Prahalad and Hammond, 2002: 12). Although the new product sold at only about 0.04 dollars per serving, its profitability was based on a rapid and wide acceptance among the poor.

As regards IT itself, there are already many examples of innovations designed by Western multinationals for poor, digitally excluded groups in developing countries. I can cite but a few. Multinational firms such as Motorola and Vodafone are selling ultra low-cost mobile handsets in poor developing countries. Other multinationals are selling computer training courses for low-income groups using large numbers of telecentres and local languages. Still others are beginning to provide telecentres in rural areas of developing countries, places where various types of IT are made available at very low cost. The problem, however, is that at this stage the amount of interest exhibited by multinationals in ventures involving IT for poor users seems to be globally rather limited (however profitable many such ventures may seem to be). Only time will tell whether these firms are willing and able to provide a major

self-interested response to the digital divide on behalf of rich countries.

From the supply-side point of view, much of the responsiveness shown by firms in developed countries may depend on the degree to which these firms see a need to transfer knowledge about IT to (small) local enterprises that supply them with inputs. For, as noted above in the discussion over GPT, the information revolution is as much about firms as it is about households and it may be the case that multinational firms need to impart technological knowledge about this proprietary technology to local firms (in order, say, to satisfy certain demands about quality). In general, the ability of a developing country to obtain knowledge about IT from firms based in industrialized countries is likely to depend on the bargaining power it can exert over such firms. Demands made by the Brazilian or Chinese government to share technology, for example, are backed by a very large and relatively affluent local market. This factor, too, must be added to the variables described earlier in this section, which have a bearing on the question of whether developed country enterprises are likely to respond positively to the challenge of reducing the digital divide.

Bridging the digital divide

I located the source of the digital divide in the tendency for IT to be generated in and for the socio-economic conditions prevailing in rich countries rather than poor countries. It is this tendency that largely accounts for the skewed pattern of diffusion of the Internet and mobile phones in favour of the former countries, who are then far better able to exploit the advantages that these technologies afford. From this way of looking at the issue, it follows that the challenge of bridging the digital divide lies, to a large extent, in finding alternative ITs and institutions that better meet the needs of poor people in poor countries (by institutional change, I am referring specifically to alternatives other than ownership as a means of exploiting the opportunities afforded by the new digital technology).

Early efforts tended to focus on the hardware/software part of the problem. One can point, for example, to the recycling of 'obsolete' computers from developed to developing countries, to the design of ultra low-cost computers (such as the 'Simputer' in India; to indigenous innovations of wireless local loop (WLL) technology such as 'CorDect' in that country; to the promotion of open-source technology and to combinations of low-cost computers and software applications).[15] It gradually became apparent, however, that unless alternatives to the developed-country institution of private ownership could be found, only a very small number of persons would be able to exploit the benefits of IT. As I noted above, it is difficult for many of those living in rural areas of developing countries to purchase even low-cost mobile phones, let alone computers and Internet connectivity (which is not to say, of course, that alternative forms of these technologies have no role to play under alternative *institutional* arrangements. Indeed, the best options seem to me to be precisely those that *combine* hardware/software innovations with new institutional forms).

Changes in the institutional context tend to take two basic forms, depending on which of the two primary assumptions of the ownership model are rejected. The first of these assumptions is that use derives entirely from ownership while the second is that the benefits of IT are extracted by the individual or the household (James, 2006b). 'In the case of the first assumption, institutional change needs to replace ownership as a means of gaining use of ITs, whereas in the second case the task is to find ways of gaining benefits of these technologies without any individual use of them whatsoever' (James, 2006b: 90). Generally speaking the latter option will be most relevant in cases where the gap between actual and required user capabilities is very large (as is often the case with the Internet in rural areas), whereas the former will apply to circumstances in which that gap is small or non-existent (as is the case, most obviously, with mobile phones). In the case of mobile phones the need is to find sharing mechanisms of one kind or another, whereas in the case of the Internet, what are needed are innovations that enable even the rural poor to benefit without any individual use of this technology whatsoever. Table 4 presents a selected

Table 4 Illustrative cases of institutional change in mobile phones and the Internet

Institutional change to expand users *Mobile phones*	*Institutional change to derive benefits without use* *The Internet*
(a) Non-commercial Sharing a mobile phone by the friends and family of owners	*(a) Face-to-face intermediation* Rural Internet kiosks that are operated by people familiar with the technology and the local community (enabling poor, illiterate rural inhabitants to have e-mails sent and government documents received).
(b) Commercial • Buying time from vendors situated in villages, small towns, roadside kiosks • People who cannot afford a mobile phone use prepaid cards to make calls from a handset belonging to someone else	*(b) Distance intermediation* Community radio stations that transmit, translate and contextualize information from the Internet for the benefit of listeners (even those living in remote, rural areas).

Source: James (2006a).

sample of institutional changes that have already taken place with regard to both forms of IT.

There is an important difference between the types of examples shown in the two columns. In particular, whereas those that involve mobile phones are about different forms of sharing arrangements, the entries in the second column depend entirely on the existence of an intermediary who comes between the technology and the users (such as the persons who broadcast radio programmes on the basis of the Internet or those who sell Internet services in rural kiosks to illiterate, poor rural inhabitants). Note, however, that this sharp division between mobile telephony and the Internet is somewhat overdrawn in practice. The long-awaited $100 laptop designed by the MIT Media Lab to run on wind-up technology illustrates this point with particular clarity as this innovation is not meant for private ownership or for use only by an intermediary. It is designed instead to be owned by governments and made available for use by schoolchildren.

The problem with these and (similar) institutional mechanisms is not that they do not work. Indeed, each of them currently benefits a large number, running typically into the millions of people in developing countries (recall, in this regard, the Grameen Telecom initiative that reaches some 45 million villagers in Bangladesh, and note also that in African countries each owner of a mobile phone shares it with five or six family members, not to speak of close friends).[16] The problem is rather that these examples have not penetrated *more widely*. Referring again to the successful Grameen case, for example, I noted above that it has thus far been replicated in only two African countries.

As I see it therefore the focus of policy should be on replicating (where relevant) the existing (successful) models and discovering new institutional forms that are appropriate to developing, rather than developed countries. And this should be done, as far as possible, in conjunction with suitable hardware innovations. Sharing schemes to widen access to mobile phones, for instance, should also include ultra low-cost handsets (at least in Africa, for example, 'the actual cost of the mobile handset is one of the key inhibitors to ownership, pointing to an area of intervention in promoting increased access'; Tusubira *et al*., 2005: 172). Or again, a successful privately owned Indian firm called 'n-Logue' was established on the basis of low-cost WLL technology combined with rural Internet kiosks (Jayaraman, 2002).[17] The logic behind this endeavour is that the cost of setting up a rural Internet kiosk is substantially reduced, thereby making it attractive to local entrepreneurs who offer Internet services to a relatively large number of villagers in the area. This model too, however, has not been spread anywhere near as widely as it should have.

The general point here is not that replication is an easy process. Far from it, but whereas there are any number of 'success' stories to be found in the literature on IT and development, the issue of replication has suffered from comparative neglect.

Conclusions

One of the more paradoxical aspects of the literature on the digital divide is that although it is so voluminous it contains remarkably little reliable evidence on the most crucial debates on the topic. Too much of the research effort has gone into the niceties of measuring the divide[18] and too little has been devoted to establishing whether the topic warrants the attention that has been lavished on it.

These observations notwithstanding, such data as are available do throw some useful light on the questions posed at the outset of the paper (as opposed to all possible questions that arise on this very large topic). One body of evidence showed, for example, that the pattern of diffusion between and within countries closely reflects what the notion of technological dualism would tend to predict and that this outcome in turn skews the impact of IT in favour of rich countries (thus validating the usefulness of the analytical schema presented in Figure 1, which emphasizes the interconnections between the generation, diffusion and impact of technical change). The second conclusion is that mobile phones represent an enormous foregone opportunity for many, if not most inhabitants of developing countries, not only in terms of economic growth but also in terms of poverty alleviation (a conclusion that challenges the quite widely held belief that investments in IT are somehow necessarily inferior to direct interventions in areas such as nutrition, education and health, among people described as living in poverty). At the national level, Grameen Telecom in Bangladesh stands out as an excellent example of what can be achieved with mobile telephony. Rural Internet kiosks represent as good an example as is now available, of the potential afforded by the Internet for the rural majority in developing countries. Thirdly, although there is some evidence to support the idea that, in some important sectors and sub-sectors (such as textiles and clothing), developing countries can suffer from a loss of comparative advantage (which leads to *absolute* rather than relative losses), it is not, as far as I can tell, a phenomenon that should give these countries as a whole any major grounds for concern. All in all, though, there is certainly enough evidence in the previous parts of the paper to suggest that developing countries ought to take the digital divide very seriously and all the more so given my view that it will not automatically be closed by the free play of market forces. I based this view partly on the belief that once IT has been adopted by those with relatively high incomes in developing countries, growth rates are likely to fall off quite sharply, especially in regard to computers and Internet connectivity.

The fourth and final conclusions are somewhat similar. The former concerns multinationals and in particular the finding that these firms have shown occasional interest in making investments in IT–based projects for the poorest groups in developing countries. Because this is a highly encouraging development from a policy perspective, questions arise as to whether and to what extent such endeavours will be pursued in the future, as part of the emerging paradigm referred to as 'producing for the poor profitably' (and relatedly, what governments can do to encourage any such tendency). Much the same sort of issues finally arise in relation to the innovations that have been made in hardware/software as well as in institutions, with the aim of making ITs relevant to developing countries rather than the rich countries in which they originate. Although a wide range of such initiatives were shown to

exist, they currently serve only a small fraction of those living in the rural areas of developing countries.[19] This situation needs to be urgently addressed as these innovations (especially those that involve a combination of technological and institutional change) represent, in my view, one of the most promising ways of bridging the digital divide, not only in mobile phones but also the Internet. The institutional dimension warrants special attention since, as shown above, private ownership is not a viable option in a developing country context where even low-cost handsets are beyond the reach of vast numbers of people. One could, of course, theoretically wait until incomes, education and infrastructure have increased to the levels prevailing in the rich countries, but that will in many cases (such as Africa) be far off in the future, and by then gaining a foothold in the world of IT will be much more difficult. For countries such as India and (to a lesser extent) China, however, the experience with outsourcing in software indicates that when governments act to develop appropriate education, infrastructure and access (albeit for a relatively small percentage of the population), the market (and the forces of comparative advantage) do engender a flow of wealth and knowledge from the developed world.

Notes

1 Many other divides have been detected in relation to the digital form, such as a skills divide, a cultural divide or a gender divide.
2 Note that this is not inevitably true. Some forms of production (such as the assembly of semi-conductors) are less technically demanding than, say, using the Internet effectively.
3 There is a clear analogy here with the 'appropriate technology' movement that began in the 1970s, with an avowed intention of finding alternative technologies to those imported from the rich world (Stewart, 1977).
4 India, in particular, appears to have benefited from foreign-funded R&D, which takes advantage of the availability and relatively low costs of skilled personnel in that country (Reddy, 1997).
5 Probably the best-known proponent of that view is Benjamin Compaine, who argues specifically that 'the digital divide is disappearing on its own' (2001: 334). He also sees close parallels between information technology and earlier innovations such as the automobile.
6 That alternative measures of the digital divide can give rise to such contrasting results certainly seems worrying. For one can then reasonably make both cases, namely, that the divide is increasing and that it is decreasing. As I see it, however, the issue is not really about choosing one measure over the other. It is rather that, for given growth rates in adoption, the absolute numbers tell us how long it will take before the developing countries do finally catch up with the rich.
7 Note that the entries in Table 2 do not include the emerging forms of IT such as 3G and Broadband. Since these technologies are currently concentrated in the industrialized countries, their inclusion in Table 2 would serve to make the digital divide even more pronounced. For a description of these important new forms of IT see for example ITU (2006a).
8 The requirements for the use of mobile telephony will no doubt become more demanding in the future with the 3G technology mentioned in the previous note.
9 This problem is, however, recognized by the ITU and certain other international institutions, and there is a proposal to gather comparable cross-country data on mobile use over a 3-month period.
10 Losses may be incurred in certain political regimes that regard information technology as subversive. The political basis of the digital divide has been explored by Guillen and Saurez (2005), who find that regulatory, political and social variables also account for the global digital divide.
11 This expectation is examined in some detail below.
12 The corresponding virtuous circle is that IT promotes growth, which in turn alleviates poverty and hence raises the prospect of higher growth in the future.
13 This tendency for the rural population to spend relatively high percentages of their incomes on telecom services is not unique to Bangladesh. It is also found, for example, in many poor African countries (Gillwald, 2005).
14 As demonstrated for instance in the *Global Information and Technology Report*, 2004–5, prepared by the World Economic Forum. In particular, the report finds that the ability of a nation to compete in global competition is closely tied to the extent of its use of information technology.
15 Most recently, the MIT Media Lab has introduced a $100 laptop computer, which is designed specifically for conditions in developing countries, as reflected among other ways by its reliance on wind-up technology. The idea is that it will be used by schoolchildren in those countries (the so-called 'one laptop per child' programme).
16 Examples of this and other types of sharing behaviour can be found for 10 African countries in Gillwald (2005).
17 WLL is a system that connects subscribers to the public telephone network on the basis of radio signals rather than copper wire.
18 There are currently at least six different ways of measuring the divide, the latest of which is the Digital Opportunity Index (DOI) prepared by the ITU (2006c).
19 It is encouraging to learn in this regard, that perhaps the most successful institutional innovation in information technology – Grameen Telecom – has produced a manual to assist replication in other parts of the developing world.

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